Syed Rizvi
TCET2220
Chapter 5 problems 5.1-5.8

Professor Vivianna
HW # 4 due completed11/25/2013

5.1) A 50-Ω lossless line is terminated in $Z_2 = 15 - j20\ \Omega$ .

(a) Plot the normalized impedance on a Smith chart.

$$z_2 = \frac{Z_2}{R_o} = \frac{15 - j20}{50} = .3 - j.4$$

(b) Using the Smith chart, determine the corresponding normalized admittance $y_2$.

$$y_2 = 1.2 + j1.6$$

(c) Using the result of (b), determine the actual admittance $Y_2$.

$$G_o = \frac{1}{R_o} = \frac{1}{50} = 0.02\ S$$

$$Y_2 = G_o y_2 = 0.02\ S\ (1.2 + j1.6) = .024 + j.032$$

5.2) A 50-Ω lossless line is terminated in $Y_2 = 0.01 + j0.02\ S$.

(a) Plot the normalized admittance on a Smith chart.

$$y_2 = \frac{Y_2}{G_o} = \frac{0.01 + j0.02}{0.02} = .5 + j1$$

(b) Using the Smith chart, determine the corresponding normalized impedance $z_2$.

$$z_2 = 0.4 - j0.8$$

(c) Using the result of (b), determine the actual impedance $Z_2$.

$$Z_2 = Z_o z_2 = 50(0.4 - j0.8) = 20 - j40$$

5.3) For the system of Problem 5.1, determine the VSWR and the reflection coefficient.

$$VSWR = S = 3.9$$

$$\Gamma_2 = \frac{S - 1}{S + 1} = \frac{3.9 - 1}{3.9 + 1} = 0.592/\text{-}133°$$

5.4) For the system of Problem 5.1, determine the VSWR and the reflection coefficient.

$$VSWR = S = 4.3$$

$$\Gamma_2 = \frac{S-1}{S+1} = \frac{4.3-1}{4.3+1} = 0.623/\text{-}97°$$

5.5) A 50-Ω lossless line is terminated in a real load impedance $Z_2$=$R_2$= 150**Ω**. Using a Smith chart, determine the input impedance for each of the following line lengths:

$$z_2 = \frac{Z_2}{R_o} = \frac{150}{50} = 3$$

(a) 0.15λ = $0.25 + 0.15 = 0.4$

$$z_{in} = 0.46 - j0.62$$

$$Z_{in} = R_o z_{in} = 50 \times (0.46 - j0.62) = 23 + j31$$

(b) 0.25λ = $0.25 + 0.25 = 0.5\ or\ 0$

$$z_{in} = 0.32$$

$$Z_{in} = R_o z_{in} = 50 \times 0.32 = 16$$

(c) 0.35λ = $0.25 + 0.35 = 0.6 - 0.5 = 0.1$

$$z_{in} = 0.475 + j0.625$$

$$Z_{in} = R_o z_{in} = 50 \times (0.475 + j0.625) = 23.75 + j31.25$$

(d) 0.45λ = $0.25 + 0.45 = 0.7 - 0.5 = 0.2$

$$z_{in} = 1.7 + j1.4$$

$$Z_{in} = R_o z_{in} = 50 \times (1.7 + j1.4) = 85 + j70$$

5.6) A 50-Ω lossless line is terminated in a real load admittance $Y_2$= 0.01 S. Using a Smith chart, determine the input admittance for the following line lengths:

$$G_o = \frac{1}{R_o} = \frac{1}{50} = 0.02 \qquad y_2 = \frac{Y_2}{G_o} = \frac{0.01}{0.02} = 0.5$$

(a) 0.125λ

$$y_{in} = 0.8 + j0.6$$

$$Y_{in} = G_o y_{in} = 0.02 \times (0.8 + j0.6) = 0.16 + j0.12$$

(b) 0.25λ

$$Y_{in} = 2$$

$$Y_{in} = G_o y_{in} = 0.02 \times 2 = 0.04$$

(c) 0.375λ

$$y_{in} = 0.8 - j0.6$$

$$Y_{in} = G_o y_{in} = 0.02 \times (0.8 - j0.6) = 0.16 - j0.12$$

(d) 0.50λ

$$y_{in} = 0.5$$

$$Y_{in} = G_o y_{in} = 0.02 \times 0.5 = 0.01$$

5.7) A 50-Ω lossless line is terminated in a load impedance $Z_2 = 75 + j100\Omega$.

(a) Using a Smith chart, determine the input impedance for a line of length 0.2λ.

$$z_2 = \frac{Z_2}{R_o} = \frac{75 + j100}{50} = 1.5 - j2$$

$$z_{in} = 0.34 - j0.68$$

$$Z_{in} = R_o z_{in} = 50(0.34 - j0.68) = 17 - j34$$

(b) Determine the VSWR and the reflection coefficient at the load.

$$VSWR = S = 4.6$$

$$\Gamma_2 = \frac{S - 1}{S + 1} = \frac{4.6 - 1}{4.6 + 1} = 0.643/37°$$

5.8) A 300-Ω lossless line is terminated in a load impedance $Z_2 = 150 - j240\Omega$.

(a) Using a Smith chart, determine the input impedance for a line of length 0.3λ.

$$z_2 = \frac{Z_2}{R_o} = \frac{150 - j240}{300} = 0.5 - j0.8$$

$$z_{in} = 1.18 + j1.41$$

$$Z_{in} = R_o z_{in} = 300(1.18 + j1.41) = 354 + j423$$

(b) Determine the VSWR and the reflection coefficient at the load.

$$VSWR = S = 3.5$$

$$\Gamma_2 = \frac{S - 1}{S + 1} = \frac{3.5 - 1}{3.5 + 1} = 0.556/-94°$$